together with the readout of the detected bottom. This ability to display the raw sonar data gives the operator excellent quality check facilities. The data reduction factor from raw data to digitizer is approx. 5000. Apart from an instant quality check the sonar intensity image and the corresponding digitized bottom samples can be recorded on a VCR for future use, and documentation. It also allows the operator to detect features that cannot be described in the reduced data set.

The 101 detected bottom samples are read out on a serial port up to 30 times a second. once every 500 ms. The format is X,Z relative to the acoustical center of the sonar head. Compensation for Heave, Pitch, and Roll as well as navigation is done externally.

Side Scan Sonar. The Seabat 8101 System as outfitted with side scan sonar capability and is ideal for pipeline inspection operations and general site surveys where co-location using both bathymetry and side scan is desirable. The Fugro system includes changes to the sonar head and topside processor to enable the measurement of side scan sonar data, which is made available in digital format.

With side scan, the primary intent is to form an image of the sea floor which can be used to locate and identify features and bottom conditions. Each sonar ping is used to generate a line of data. Each line contains a series of amplitudes representing the signal return vs. time or range. A higher amplitude indicates a strong reflector, which may be either the near side of a target or a more reflective surface. Low amplitudes may be the shadow of a feature or a less-reflective surface. When a series of these lines are combined and displayed, as the vessel moves along the track, a two-dimensional image is formed which provides a detailed picture of the bottom along either side of the vessel.

The side scan data is output as an array of amplitude values which represent the amplitudes for each sample cell in the beam from a single ping. The side scan beam has the same 1.5° along-track beamwidth as the bathymetry beam, but the across- track resolution is determined by the sampling rate rather than the beamwidth. The result is that each amplitude value represents an area 1.5° wide by 5 centimeters. The side scan beam is designed with a much wider beamwidth than the bathymetry beams so that each beam has a field of view from very near the vessel out to the maximum slant range of the sonar.

Computer Data Acquisition System. The Seabat 6042 combines hardware and software designed and developed to enable marine survey operators to monitor their progress and make critical decisions in real time to support their operations. Whether for pipeline placement, "rock dumping, dredging control, or hydrographic survey operations", the Seabat 6042 can record and provide the required information.

The operator is in full control of each area of the Seabat 6042 process from data storage to information display. Numerous pre-defined windows are available to view collected and corrected multibeam data, single/dual profile's, plan view, 3D wiggle, and water-fall type displays can be selected. The Seabat 6042 time tags all received sensor data to an accuracy of one millisecond, interfaces to a Grid Coordinate System, and stores all raw data for instant, replay or transfer to a chart mapping system.

Sound Velocimeter. An AML SV Plus velocimeter is a lightweight, rugged, intelligent profiler which records high resolution sound velocity profiles of a water Column to depths of 5000 meters. Sound velocity is measured directly using an acoustic time of flight sensor rather than calculated from CTD measured parameters. The SV Plus offers the options of logging data continuously, at user selected depth increments, time increments, sound velocity increments, or upon request. The output format can be configured for "real" computed engineering values or "raw" integers for post processing. A standard feature of every SV Plus is AML's powerful, user friendly "*Total System Software*" *TSS* allows for viewing, editing, printing and graphing of data logged by the instrument.

F-9

4.0 SURVEY PROCEDURES

The lease survey covered an area of approximately 2,150 feet x 1,250 feet with water depths ranging from approximately 20 to 62 feet. To provide complete coverage of the area, data was collected along 23 survey lines.

Line spacing was utilized to provide for 200% coverage of the seafloor (for multibeam) even in the event of extreme vessel roll conditions, and irregular vessel line steerage.

A summary of the field operations, instrumentation deployment methods and survey layouts for data acquisition is discussed in the following sections.

4.1 Multibeam Bathymetry

Prior to operations a comprehensive calibration was carried out to calibrate the different components of the multi-beam system. The multibeam calibration accurately measures the angular mounting components of the correction sensors (roll, pitch, and yaw) - errors in these measurements can lead to inaccurate surveys. The calibration test is a data collection and processing procedure to calibrate these angles along with position system latency. These calibration tests were conducted prior to commencing field operations.

During survey operations all correction sensor and multibeam data was time tagged and logged with the 6042 data acquisition system. At the start of the survey speed of sound in seawater was determined by a sound velocimeter profile. Correction sensor calibration factors and sensor offsets were applied during data collection. Sound velocity profile data and tide corrections were applied in post processing. and correlated with the survey data.

4.2 Side Scan Sonar

The side scan system was adopted for this survey to provide sonar imagery of debris and bedrock features. The side scan sonar records can be used to provide interpretation of possible debris, hard-bottom features, and other anomalies.

F10

During field operations, the sonar was tuned and adjusted to find the best combination of control settings that yielded the best resolution.

The 8101 side scan was operated at optimum slant range based on changing water depth. Side scan data was collected concurrently with the bathymetry along the same survey lines as the multibeam system. These data were displayed shipboard on the 6042 data acquisition system while slant range and speed correction were applied.

During the field survey the 8101 sonar sensor was hard mounted on the side fo the survey vessel. Layback from the inertial navigation sensor was zero.

5.0 DATA PROCESSING TECHNIQUES

The following sections detail the post-processing procedures for each system. All mapping was completed at a workstation using TerraModel and AutoCAD. No digitizing of paper records was used in order to provide the most precise positions of features possible. Personnel involved with all phases of the survey and subsequent data processing are listed in Appendix C.

Initial bathymetric data processing was conducted daily onsite to verify data quality and coverage. Final data processing and presentation was performed at the Fugro office in Ventura, California. Data collected during the survey were excellent due to favorable weather along with careful operation of the survey instruments. The following sections describe the data processing techniques used to reduce the raw field data to its final form for presentation.

5.1 Navigation Processing

Appendix B lists the navigation survey parameters used during the acquisition of data and subsequent data reduction. Navigation data recorded during the project were edited and utilized to map the data from the Seabat sensors

F11

5.2 Multibeam Bathymetric Data Processing

Two data processing software packages were used for all of the multi-beam data. Hysweep by Coastal Oceanographics was used to edit and bin the raw multi-beam data set consisting of several million discrete xyz data points. A sophisticated data decimator by was utilized to thin the binned data set prior to modeling and contouring of the data.

Terramodel and Terravista Digital Terrain Modeling (DTM) software packages by Spectra Precision were used to contour and generate 3-D models of the edited bathymetry data and produce the final maps. Processing procedures are outlined as follows:

- Raw multi-beam data collected with the Reson 6042 was converted to Hypack's Hysweep format using Reson's R6042 program.

- Tide and Sound Velocity correction data files were developed in Hypack format from sound velocimeter data and tidal reduction curves generated from NOAA tidal data for the area.

- Data coverage was verified using Hysweep's Replay mode and a 2 meter BIN size MATRIX file was constructed.

- Hypack's Sweep Editor was used to merge and edit the raw multi-beam, Tide, Sound Velocity Profile, Heading, and Motion Sensor data to produce edited x,y,z data points corrected to MLLW. Valid data points were selected based on using only Quality 3 data from the Seabat. Data points registered as Quality 0 through 2 were discarded from the data set.

- The corrected x,y,z, data points were then imported into Hypack's Sort and Mapper functions and merged with the 1.5 meter BIN Matrix file. Edited data was then processed into a 1.5 meter grid size with the average of the grid readings placed in the center of the grid cell to create the final data set.

F12

The final data set was imported into the Terramodel DTM software to produce the bathymetric contours for the final map. The contours are shown on the Bathymetry and Seafloor Features Maps located in the Appendices at the back of this report.

5.3 Side Scan Sonar Processing

Side scan sonar records were analyzed in conjunction with the bathymetry data for evidence of objects on the seafloor and other evidence of human activity and geophysical processes. The objects of search included all sonar features with acoustic shadow (indicating projection above the seafloor) and seafloor topographic features such as mounds, depressions, rises, scour and areas of disturbed seafloor indicated by disposal activities and anchor drag and trawl scars. Areas of seafloor change, debris, and bedrock outcrop were also noted and mapped as part of the survey. All side scan sonar data were analyzed in conjunction with the multibeam data. All such features, or clusters of such features, were plotted at their respective locations on the Bathymetry and Seafloor Features Maps. In addition to the known objects, the sonar system detected a number of smaller debris targets. Target detection by the sonar system can vary depending on the physical orientation of the target or the presence of small, localized undulations of the seabed.

6.0 RESULTS

Data interpretation was performed at the Fugro office in Ventura, California. The following sections describe the bathymetry and seafloor features observed from the field data for the survey.

6.1 Multibeam Bathymetry

Bathymetric contours referenced to Mean Lower Low Water (MLLW) for the area are mapped on the *Bathymetry and Seafloor Features Map.* Water depths within the surveyed area range from 20 feet near-shore at the kelp line to 61 feet along the southeast side of the lease block. No noticeable topographic anomalies other than bedrock outcrops were detected within the survey area.

6.2 Side Scan Sonar

Several large areas of bedrock outcrop are seen on the sonar records. A large portion of the survey area shallower than 42 feet is characterized as rock outcrop. Thick kelp was encountered throughout the survey in water depths shallower than 20 feet. This limited the survey with the boat unable to penetrate into the kelp beds. Bedrock outcrops are mapped on the Bathymetry and Seafloor Features Map. The structure in PRC-421 know locally as *"Bird Island"* located at E: 1424153, N: 341688 (NAD27); 34° 25' 25.99"N, 119° 54' 38.02":W (NAD83) is shown on the Bathymetry and Seafloor Features Map. Visible below and surrounding the structure is what appears to be an area of debris of shell buildup. It is also possibly more rock outcrop. Several old piling were visible shoreward of the structure marking the location of an old pier. These pilings appear to have minimal vertical relief.

The focus of this survey is to locate potential man-made debris targets. These features area mapped at their locations on the Bathymetry and Seafloor Features Maps. A tabulated summary of the sonar targets as interpreted from the side scan sonar data is included in the table below. Each target number is also labeled on the Bathymetry and Seafloor Features Maps.

Target ID	NAD27 CAL ZONE 5 Easting	Northing	NAD83 Latitude	Longitude	Description
1	1423653	340651	34 25 15.64N	119 54 43.76W	Linear Target 6' Long
2	1423962	341260	34 25 21.72N	119 54 40.21W	Cable or Chain 15' Long
3	1423753	341229	34 25 21.38N	119 54 42.69W	Square Shaped Target 3' Long
4	1423900	341382	34 25 22.92N	119 54 40.97W	Linear Target 16' Long
5	1424005	341703	34 25 26.11N	119 54 39.79W	Square Shaped Target 3' Long
6	1423631	341496	34 25 23.99N	119 54 44.21W	Linear Target 4' Long
7	1423832	341799	34 25 27.03N	119 54 41.88W	Linear Target 15' Long
8	1424108	341651	34 25 25.62N	119 54 38.55W	Three Linear Targets 33', 40' and 55' Long

In addition to the sonar anomaly table above sonar data for each target is included in Appendix A.